IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Jeng H. Hwang et al.	§	GROUP ART UNIT: 1756 (Parent Application)
SERIAL NO.: 09/421,467	§	
FILED: October 19, 1999	§	EXAMINER: N. Barreca (Parent Application)
FOR: MASKING METHODS AND ETCHING SEQUENCES FOR PATTERNING ELECTRODES OF HIGH DENSITY RAM CAPACITORS	§	Attorney Docket No.: AM-2602.C1

Date: January 24, 2002

PRELIMINARY AMENDMENT "A"

Hon. Commissioner for Patents
Washington, DC 20231

Sir:

This Preliminary Amendment "A" accompanies a continuation application of U.S. Application Serial No. 09/421,467, filed October 19, 1999.

CERTIFICATE OF MAILING UNDER 37 CFR § 1.10

I hereby certify that this paper and any documents said to accompany this paper are being deposited with the U.S. Postal Service on the date shown below with sufficient postage as U.S. EXPRESS MAIL NO. EU092830426US in an envelope addressed to the: Commissioner for Patents, Box Patent Application, Washington, DC 20231.

Date: January 24, 2002

Shirley L. Church

Shirley L. Church, Reg. No.31,858

Please amend the application as follows.

IN THE SPECIFICATION:

Please replace the paragraph at page 1, lines 5 - 11, with the following rewritten paragraph:

-- This application is a continuation application of Application Serial No. 09/421,467, filed October 19, 1999, which is currently pending. Application Serial No. 09/421,467 is a continuation-in-part of the following applications: Serial No. 09/251,588, filed February 17, 1999, which is abandoned; Serial No. 09/251,826, filed February 17, 1999, which issued as U.S. Patent No. 6,323,132, on November 27, 2001; and Serial No. 09/251,633, which issued as U.S. Patent No. 6,265,318, on July 24, 2001. Application Serial Nos. 09/251,588; 09/251,826; and 09/251,633 are continuations-in-part of Application Serial No. 09/006,092, filed January 13, 1998, which is abandoned. --

Please delete the paragraph at page 1, lines 12 - 24, in its entirety.

IN THE ABSTRACT:

Please replace the Abstract, at page 118, lines 4 - 18, with the following rewritten Abstract:

-- A method of etching a noble metal electrode layer disposed on a substrate to produce a semiconductor device including a plurality of electrodes separated by a distance equal to or less than about 0.35 μm and having a noble metal profile equal to or greater than about 80°. The method comprises heating the substrate to a temperature greater than about 150°C, and etching the noble metal electrode layer by employing a high density inductively coupled plasma of an etchant gas comprising a gas selected from the group consisting of nitrogen, oxygen, a halogen (e.g., chlorine), argon, and a gas selected from the group consisting of BCl_3, HBr, and $SiCl_4$ mixtures thereof.

Masking methods and etching sequences for patterning high density RAM capacitors are also provided. --

IN THE CLAIMS:

Please amend the claims as follows.

Claims not being amended are presented in italics for reference purposes.

1. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a protective layer on said noble metal layer, a mask layer on said protective layer, and a patterned resist layer on said mask layer, wherein said protective layer and said mask layer comprise inorganic materials;

b) pattern etching said mask layer using a plasma generated from an etchant gas to expose a portion of said protective layer;

c) removing said patterned resist layer from said mask layer;

d) pattern etching said protective layer to expose a portion of said noble metal layer;

e) heating said noble metal layer to a temperature ranging from about 150°C to about 500°C;

f) pattern etching said noble metal layer using a plasma generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof;

g) removing said mask layer from said protective layer; and

h) pattern etching said barrier layer using a plasma generated from an etchant gas, to expose a portion of said substrate.

2. (Once Amended) The method of Claim 1 wherein, after completion of step g), there is residual noble metal on a surface of said barrier layer, and wherein said method comprises an additional step g-2) after step g), in which said residual noble metal is removed from said barrier layer prior to said step (h) pattern etching of said barrier layer.

3. (Once Amended) The method of Claim 1 wherein said method comprises an additional step g-2) after step g), in which residual protective layer material is removed from said noble metal layer.

4. (Once Amended) The method of Claim 1 wherein, after completion of step g), there is residual noble metal on a surface of said barrier layer, and wherein said method comprises an additional step g-2) after step g), in which said residual noble metal and any remaining protective layer material are removed prior to said step (h) pattern etching of said barrier layer.

5. (Once Amended) The method of Claim 3 wherein said removing of said protective layer from said noble metal layer is simultaneous with pattern etching of said noble metal layer.

6. *The method of Claim 1 wherein said mask layer comprises CVD SiO_2.*

7. (Once Amended) The method of Claim 2 wherein said mask layer and said substrate each comprises CVD SiO_2.

8. *The method of Claim 4 wherein said mask layer comprises CVD SiO_2.*

9. (Once Amended) The method of Claim 1 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, and mixtures thereof.

10. The method of Claim 1 wherein said barrier layer comprises a compound selected from the group consisting of TiN, TiSiN, Ti, WN, TaN, TaSiN, Ta, and mixtures thereof.

11. The method of Claim 1 wherein said protective layer comprises a compound selected from the group consisting of TiN, TiSiN, Ti, WN, TaN, TaSiN, Ta, and mixtures thereof.

12. The method of Claim 1 wherein said mask layer has a thickness ranging from about 6000Å to about 9,000Å.

13. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, an inorganic mask layer on said noble metal layer, and a patterned resist layer on said mask layer;

b) pattern etching said mask layer using a plasma generated from an etchant gas to expose a portion of said noble metal layer;

c) removing said patterned resist layer from said mask layer;

d) heating said noble metal layer to a temperature ranging from about 150°C to about 500°C;

e) pattern etching said noble metal layer using a plasma generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof;

f) removing said mask layer from said etched noble metal layer; and

g) pattern etching said barrier layer using a plasma generated from an etchant gas to expose a portion of said substrate.

14. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a protective layer on said noble metal layer, a mask layer on said protective layer, and a patterned resist layer on said mask layer, wherein said protective layer and said mask layer comprise inorganic materials;

b) pattern etching said mask layer using a plasma generated from an etchant gas to expose a portion of said protective layer;

c) removing said patterned resist layer from said mask layer;

d) pattern etching said protective layer to expose a portion of said noble metal layer ;

e) pattern etching said noble metal layer using a plasma generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof, at a substrate temperature between about 150°C and about 500°C;

f) pattern etching said barrier layer using a plasma generated from an etchant gas to expose a portion of said substrate; and

g) removing said mask layer from said protective layer.

15. The method of Claim 14 wherein said barrier layer comprises a compound selected from the group consisting of TiN, TiSiN, Ti, WN, TaN, TaSiN, Ta, and mixtures thereof.

16. The method of Claim 14 wherein said protective layer comprises a compound selected from the group consisting of TiN, TiSiN, Ti, WN, TaN, TaSiN, Ta, and mixtures thereof.

17. The method of Claim 14 wherein said mask layer has a thickness ranging from about 6000Å to about 9,000Å.

18. (Once Amended) The method of Claim 1 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, and mixtures thereof.

19. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting an etch-stop layer, a barrier layer on said etch-stop layer, a noble metal layer on said barrier layer, an inorganic mask layer on said noble metal layer, and a patterned resist layer on said mask layer;

b) pattern etching said mask layer using a plasma generated from an etchant gas to expose a portion of said noble metal layer;

c) removing said patterned resist layer from said mask layer;

d) pattern etching said noble metal layer using a plasma generated from an etchant gas consisting essentially of a halogen containing gas, a noble gas, and an additive selected from the group consisting of HBr, BCl_3, and mixtures thereof , at a substrate temperature between about 150°C and about 500°C;

e) pattern etching said barrier layer to expose a portion of said etch-stop layer; and

f) removing said mask layer from said etched noble metal layer.

20. (Once Amended) The method of Claim 19 wherein said method additionally comprises the step of etching said etch-stop layer.

21. (Once Amended) The method of Claim 19 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, and mixtures thereof.

22. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a first mask layer on said noble metal layer, a second mask layer on said first mask layer, and a patterned resist layer on said second mask layer, wherein said first mask layer and said second mask layer comprise inorganic materials;

b) pattern etching said second mask layer using a plasma generated from an etchant gas to expose a portion of said first mask layer;

c) pattern etching said first mask layer to expose a portion of said noble metal layer;

d) removing said patterned resist layer from said second mask layer;

e) pattern etching said noble metal layer and said second mask layer using a plasma generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof, at a substrate temperature between about 150°C and about 500°C;

f) pattern etching said barrier layer; and

g) removing said first mask layer from said etched noble metal layer.

23. (Once Amended) The method of Claim 22 wherein said patterned resist layer is removed from said second mask layer during etching of said first mask layer.

24. (Once Amended) The method of Claim 22 wherein said first mask layer comprises a compound selected from the group consisting of Si_3N_4, BSG, PSG, BPSG, and mixtures thereof.

25. The method of Claim 22 wherein said second mask layer comprises a compound selected from the group consisting of CVD SiO_2, TEOS, Si_3N_4, BSG, PSG, BPSG, SiC, and mixtures thereof.

26. The method of Claim 22 wherein said first mask layer has a thickness ranging from about 3000Å to about 8000Å.

27. The method of Claim 22 wherein said second mask layer has a thickness ranging from about 500Å to about 4000Å.

28. (Once Amended) The method of Claim 22 wherein said substrate is etched during etching of said barrier layer.

REMARKS

The Abstract of the disclosure has been shortened to less than 150 words.

Various claims have been amended as set forth above in order to clarify the claim language in a manner which more closely reflects what applicants regard as their invention. For example, in Claims 9, 18, 21, and 24, the claim language recited a Markush group which included one member of the group as "a low dielectric constant material with a dielectric constant less than about 3.0". This claim language was broader in scope than desired. Applicants' removal of this member of the group does not indicate that low k dielectric materials are not used in the particular method being claimed, but is intended to make the claim scope more particular.

Applicants' claims have been amended to recite that the mask layer and protective layer materials are inorganic. In particular, independent Claims 1 and 14 have been amended to recite that the mask layer and the protective layer comprise inorganic materials; independent Claims 13 and 19 have been amended to recite that the mask layer is an inorganic mask layer; and independent Claim 22 has been amended to recite that the first mask layer and the second mask layer comprise inorganic materials.

Independent Claims 1, 13, 14, 19, and 22 have been further amended to recite that pattern etching of the noble metal layer is conducted at a temperature ranging between about 150°C and about 500°C. These amendments are supported in the originally filed specification at, for example: page 11, lines 21 - 22; page 15, lines 11 - 12; page 16, lines 24 - 25; page 25, lines 11 - 12; and page 31, lines 22 - 23.

In order to clarify what applicants regard as their invention, Claim 2 has been amended to recite that, after completion of step g), there is residual noble metal on a surface of the barrier layer, and that to remove this residual noble metal, an additional step, g-2), is conducted prior to step h), in which the barrier layer is etched. Claim 4 has been amended to recite that, after completion of step g), there is residual noble metal on a surface of the barrier layer, and that to remove this residual

noble metal and any remaining protective layer material, an additional step, g-2), is conducted prior to step h), in which the barrier layer is etched.

In order to clarify what applicants regard as their invention, step d) of Claim 14 has been amended to remove reference to the patterned resist layer, which was removed in step c).

In order to clarify what applicants regard as their invention, independent Claim 19 has been amended to recite a more specific plasma source gas, which may be used to etch noble metals, and which is typically used to etch platinum. Support for this amendment is found at page 24, lines 21 - 25, of applicants' originally filed specification.

The amendments to the claims set forth above are fully supported by the originally filed specification, claims, and drawings, and no new matter has been added to the claims by the amendments set forth above.

Applicants would like to mention that the amendments to the claims set forth above were made solely for the purpose of expediting allowance of the present application. The amendments should not be construed as agreement with or acquiescence to the Examiner's grounds for rejection of claims in the parent application.

Applicants believe that the presently pending claims as amended are in condition for allowance, and the Examiner is respectfully requested to enter the requested amendments and to pass the application to allowance. The Examiner is invited to contact applicants' attorney with any questions or suggestions, at the telephone number provided below.

Respectfully submitted,

Shirley L. Church

Shirley L. Church
Registration No. 31,858
Attorney for Applicant
(408) 245-5109

Correspondence Address:
Patent Counsel
Applied Materials, Inc.
P.O. Box 450-A
Santa Clara, CA 95052

AMENDMENT "A" UNDER 37 CFR § 1.111
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph at page 1, lines 5 - 11, has been amended as follows.

This application is a [continuation-in-part patent] continuation application of [copending patent application entitled "MASKING METHODS AND ETCHING SEQUENCES FOR PATTERNING ELECTRODES OF HIGH DENSITY RAM CAPACITORS,"] Application Serial No. 09/421,467, filed October 19, 1999, which is currently pending. Application Serial No. 09/421,467 is a continuation-in-part of the following applications: Serial No. 09/251,588, filed February 17, 1999 [. Copending patent application Serial No.] , which is abandoned; Serial No. 09/251,826, filed February 17, 1999, which issued as U.S. Patent No. 6,323,132, on November 27, 2001; and Serial No. 09/251,633, which issued as U.S. Patent No. 6,265,318, on July 24, 2001. Application Serial Nos. 09/251,588 [is a continuation-in-part patent application of copending patent application entitled "ETCHING METHODS FOR ANISOTROPIC PLATINUM PROFILE,"] ; 09/251,826; and 09/251,633 are continuations-in-part of Application Serial No. 09/006,092, filed January 13, 1998 , which is abandoned.

The paragraph at page 1, lines 12 - 24, has been deleted in its entirety.

IN THE ABSTRACT:

The Abstract, at page 118, lines 4 - 18, has been amended as follows.

A method of etching a noble metal electrode layer disposed on a substrate to produce a semiconductor device including a plurality of electrodes separated by a distance equal to or less than about 0.35 μm and having a noble metal profile equal to or greater than about 80°. The method comprises heating the substrate to a temperature greater than about 150°C, and etching the noble

metal electrode layer by employing a high density inductively coupled plasma of an etchant gas comprising a gas selected from the group consisting of nitrogen, oxygen, a halogen (e.g., chlorine), argon, and a gas selected from the group consisting of BCl_3, HBr, and $SiCl_4$ mixtures thereof. [A semiconductor device having a substrate and a plurality of noble metal electrodes supported by the substrate. The noble metal electrodes have a dimension (e.g., a width) which includes a value greater to or less than about 0.3 μm and a platinum profile equal to or greater than about 85°.] Masking methods and etching sequences for patterning high density RAM capacitors are also provided. [The substrate may be heated by a pedestal in a reactor chamber having a dielectric window including a deposit-receiving surface having a surface finish comprising a peak-to-valley roughness height with an average height value of greater than about 1,000Å.]

IN THE CLAIMS:

Claims 1 - 5, 7, 9, 13, 14, 18 - 24, and 28 have been amended as follows.

1. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a protective layer on said noble metal layer, a mask layer on said protective layer, and a patterned resist layer on said mask layer , wherein said protective layer and said mask layer comprise inorganic materials ;

b) pattern etching [a portion of] said mask layer [including employing] using a plasma [of a mask] generated from an etchant gas [to break through and to remove said portion of said mask layer from said protective layer] to expose [part] a portion of said protective layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, said

protective layer on said noble metal layer, a residual mask layer on said protective layer, and said patterned resist layer on said residual mask layer] ;

c) removing said patterned resist layer from said [residual] mask layer [of step (b) to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, said protective layer on said noble metal layer, and said residual mask layer on said protective layer] ;

d) pattern etching said [exposed part of said] protective layer to expose [part] a portion of said noble metal layer [and to produce said substrate supporting said barrier layer, and said noble metal layer on said barrier layer, a residual protective layer on said noble metal layer, and said residual mask layer on said residual protective layer] ;

e) heating said noble metal layer [substrate of step (d)] to a temperature [greater than] ranging from about 150°C to about 500°C ;

f) pattern etching said [exposed part of said] noble metal layer [of step (d) including employing] using a plasma [of] generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof [, to produce said substrate supporting said barrier layer, an etched noble metal layer on said barrier layer, said residual protective layer on said etched noble metal layer, and said residual mask layer on said residual protective layer;

g) removing said [residual] mask layer from said [residual] protective layer [to produce said substrate supporting said barrier layer, said etched noble metal layer on said barrier layer, and said residual protective layer on said etched noble metal layer] ; and

h) pattern etching [a portion of] said barrier layer [including employing] using a plasma [of a barrier] generated from an etchant gas to expose [part] a portion of [the] said substrate [to produce said substrate supporting a residual barrier layer, said etched noble metal layer on said residual barrier layer, and said residual protective layer on said etched noble metal layer].

2. (Once Amended) The method of Claim 1 wherein [said step (g) etching of said noble metal layer of step (d) additionally produces a remaining noble metal layer on] , after completion of step g), there is residual noble metal on a surface of said barrier layer , and wherein said method comprises an additional step g-2) after step g), in which [said step (g) removing of said residual mask layer additionally produces said remaining noble metal layer on said barrier layer, and said method additionally comprises etching said remaining] said residual noble metal [layer on] is removed from said barrier layer prior to said step (h) pattern etching said barrier layer.

3. (Once Amended) The method of Claim 1 wherein said method [additionally comprising] comprises an additional step g-2) after step g), in which [removing said] residual protective layer material is removed from said [etched] noble metal layer.

4. (Once Amended) The method of Claim 1 wherein [said step (f) etching of said noble metal layer of step (d) additionally produces a remaining noble metal layer on] , after completion of step g), there is residual noble metal on a surface of said barrier layer, and wherein said method comprises an additional step g-2) after step g), in which [said step (g) removing of said residual mask layer additionally produces said remaining noble metal layer on said barrier layer, and said method additionally comprises etching] said residual noble metal and any remaining protective layer material [and said remaining noble metal layer on said barrier layer] are removed prior to said step (h) pattern etching of said barrier layer.

5. (Once Amended) The method of Claim 3 wherein said removing of said [residual] protective layer from said [etched] noble metal layer is simultaneous with [said] pattern etching [step (h)] of said noble metal layer.

7. (Once Amended) The method of Claim 2 wherein said mask layer and said substrate each comprises CVD SiO_2.

9. (Once Amended) The method of Claim 1 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, [a low dielectric constant material with a dielectric constant less than about 3.0,] and mixtures thereof.

13. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, [a] an inorganic mask layer on said noble metal layer, and a patterned resist layer on said mask layer;

b) pattern etching [a portion of] said mask layer [including employing] using a plasma [of a mask] generated from an etchant gas [to break through and to remove said portion of said mask layer from said noble metal layer] to expose [part] a portion of said noble metal layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, a residual mask layer on said noble metal layer, and said patterned resist layer on said residual mask layer];

c) removing said patterned resist layer from said [residual] mask layer [of step (b) to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, and said residual mask layer on said noble metal layer] ;

d) heating said noble metal layer [substrate of step (c)] to a temperature [greater than] ranging from about 150°C to about 500°C ;

e) pattern etching said [exposed part of said] noble metal layer [of step (c) including employing] using a plasma [of] generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof [, to produce said

substrate supporting said barrier layer, an etched noble metal layer on said barrier layer, and said residual mask layer on said etched noble metal layer;

f) removing said [residual] mask layer from said etched noble metal layer [to produce said substrate supporting said barrier layer and said etched noble metal layer on said barrier layer]; and

g) pattern etching [a portion of] said barrier layer [including employing] using a plasma [of a barrier] generated from an etchant gas to expose [part] a portion of [the] said substrate [to produce said substrate supporting a residual barrier layer and said etched noble metal layer on said residual barrier layer].

14. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a protective layer on said noble metal layer, a mask layer on said protective layer, and a patterned resist layer on said mask layer , wherein said protective layer and said mask layer comprise inorganic materials ;

b) pattern etching [a portion of] said mask layer [including employing] using a plasma [of a mask] generated from an etchant gas [to break through and to remove said portion of said mask layer from said protective layer] to expose [part] a portion of said protective layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, said protective layer on said noble metal layer, a residual mask layer on said protective layer, and said patterned resist layer on said residual mask layer] ;

c) removing said patterned resist layer from said [residual] mask layer [of step (b) to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, said protective layer on said noble metal layer, and said residual mask layer on said protective layer] ;

d) pattern etching said [exposed part of said] protective layer to expose [part] a portion of said noble metal layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, a residual protective layer on said noble metal layer, said residual mask layer on said residual protective layer, and said patterned resist layer on said residual mask layer];

e) [heating said substrate of step (d) to a temperature greater than about 150°C;

f)] pattern etching said [exposed part of said] noble metal layer [of step (d) including employing] using a plasma [of] generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof, at a substrate temperature between about 150°C and about 500°C; [to produce said substrate supporting said barrier layer, an etched noble metal layer on said barrier layer, said residual protective layer on said etched noble metal layer, and said residual mask layer on said residual protective layer;

g)] f) pattern etching [a portion of] said barrier layer [including employing] using a plasma [of a barrier] generated from an etchant gas to expose [part] a portion of [the] said substrate [to produce said substrate supporting a residual barrier layer, said etched noble metal layer on said residual barrier layer, said residual protective layer on said etched noble metal layer, and said residual mask layer on said residual protective layer] ; and

[h)] g) removing said [residual] mask layer from said [residual] protective layer [to produce said substrate supporting said residual barrier layer, said etched noble metal layer on said residual barrier layer, and said residual protective layer on said etched noble metal layer].

18. (Once Amended) The method of Claim 14 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, [a low dielectric constant material with a dielectric constant less than about 3.0,] and mixtures thereof.

19. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting an etch-stop layer, a barrier layer on said etch-stop layer, a noble metal layer on said barrier layer, [a] an inorganic mask layer on said noble metal layer, and a patterned resist layer on said mask layer;

b) pattern etching [a portion of] said mask layer [including employing] using a plasma [of a mask] generated from an etchant gas [to break through and to remove said portion of said mask layer from said noble metal layer] to expose [part] a portion of said noble metal layer [and to produce said substrate supporting said etch-stop layer, said barrier layer on said etch-stop layer, said noble metal layer on said barrier layer, a residual mask layer on said noble metal layer, and said patterned resist layer on said residual mask layer] ;

c) removing said patterned resist layer from said [residual] mask layer [of step (b) to produce said substrate supporting said etch-stop layer, said barrier layer on said etch-stop layer, said noble metal layer on said barrier layer, and said residual mask layer on said noble metal layer] ;

d) [heating said substrate of step (c) to a temperature greater than about 150°C;

e)] pattern etching said [exposed part of said] noble metal layer [of step (c) including employing] using a plasma [of] generated from an etchant gas [selected from the group consisting of] consisting essentially of a halogen containing gas, a noble gas, [nitrogen, oxygen,] and an additive selected from the group consisting of HBr, BCl_3, and mixtures thereof, at a substrate temperature between about 150°C and about 500°C; [to produce said substrate supporting said etch-stop layer, said barrier layer on said etch-stop layer, an etched noble metal layer on said barrier layer, and said residual mask layer on said etched noble metal layer;

f)] e) pattern etching said [exposed part of said] barrier layer to expose [part] a portion of said etch-stop layer [and to produce said substrate supporting said etch-stop layer, a residual barrier layer on said etch-stop layer, said etched noble metal layer on said residual barrier layer, and said residual mask layer on said etched noble metal layer] ; and

[g)] f) removing said [residual] mask layer from said etched noble metal layer [to produce said substrate supporting said etch-stop layer, said residual barrier layer on said etch-stop layer, and said etched noble metal layer on said barrier layer].

20. (Once Amended) The method of Claim 19 wherein said method additionally [comprising] comprises the step of etching said etch-stop layer.

21. (Once Amended) The method of Claim 19 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, [a low dielectric constant material with a dielectric constant less than about 3.0,] and mixtures thereof.

22. (Once Amended) A method of pattern etching a noble metal layer disposed on a substrate comprising the steps of:

a) providing a substrate supporting a barrier layer, a noble metal layer on said barrier layer, a first mask layer on said noble metal layer, a second mask layer on said first mask layer, and a patterned resist layer on said second mask layer , wherein said first mask layer and said second mask layer comprise inorganic materials ;

b) pattern etching [a portion of] said second mask layer [including employing] using a plasma [of a mask] generated from an etchant gas [to break through and to remove said portion of said second mask layer from said first mask layer] to expose [part] a portion of said first mask layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier

layer, said first mask layer on said noble metal layer, a residual second mask layer on said first mask layer, and said patterned resist layer on said residual second mask layer] ;

c) pattern etching said [exposed part of said] first mask layer to expose [part] a portion of said noble metal layer [and to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, a residual first mask layer on said noble metal layer, said residual second mask layer on said residual first mask layer, and said patterned resist layer on said residual second mask layer] ;

d) removing said patterned resist layer from said [residual] second mask layer [of step (c) to produce said substrate supporting said barrier layer, said noble metal layer on said barrier layer, and said residual first mask layer on said noble metal layer, and said residual second mask layer on said first residual mask layer] ;

e) [heating said substrate of step (d) to a temperature greater than about 150°C;

f)] pattern etching said [exposed part of said] noble metal layer and said [residual] second mask layer [of step (d) including employing] using a plasma [of] generated from an etchant gas selected from the group consisting of a halogen containing gas, a noble gas, nitrogen, oxygen, and mixtures thereof, at a substrate temperature between about 150°C and about 500°C; [to produce said substrate supporting said barrier layer, an etched noble metal layer on said barrier layer, and said residual first mask layer on said etched noble metal layer;

g)] f) pattern etching said barrier layer [to remove a portion of the barrier layer from said substrate to produce said substrate supporting a residual barrier layer, said etched noble metal layer on said residual barrier layer, and said residual first mask layer on said etched noble metal] ; and

[h)] g) removing said [residual] first mask layer from said etched noble metal layer [to produce said substrate supporting said residual barrier layer, and said etched noble metal layer on said residual barrier layer].

23. (Once Amended) The method of Claim 22 wherein said patterned resist layer is removed from said [residual] second mask layer during [said] etching [step (c)] of said first mask layer.

24. (Once Amended) The method of Claim 22 wherein said mask layer comprises a compound selected from the group consisting of TEOS, CVD SiO_2, Si_3N_4, BSG, PSG, BPSG, [an organic polymer, a low dielectric constant material with a dielectric constant less than about 3.0,] and mixtures thereof.

28. (Once Amended) The method of Claim 22 wherein said [etching step (g) additionally comprises etching into said] substrate is etched during etching of said barrier layer.